

POST GALILEO-EUROPA-MISSION SATELLITE TOUR DESIGN

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The Galileo orbiter mission as originally envisioned would orbit Jupiter eleven times, closely encountering either Europa, Ganymede, or Callisto on ten of those orbits. This nominal or prime mission began with Jupiter orbit insertion on December 7, 1995 and ended as designed ten encounters later on December 1, 1997. An extension to this nominal mission was proposed, developed and accepted in 1997 and was designed to continue orbital operations through an additional two years until December 31, 1999. This follow-on mission, labelled the Galileo Europa Mission, visits Europa eight times, Callisto four times, and ends with two visits to Io. It augments the prime mission by offering many attractive additional opportunities for science, especially remote sensing. The opportunities include increased scrutiny of Europa, a world with a possible global ocean hidden beneath the surface icecap, and the first high resolution images of Io (the only major satellite not encountered during the nominal tour).

In 1998 a new effort was begun to investigate a possible extension to GEM. Remote sensing observations will continue to be important but moreover, valuable unique *in situ* fields and particles measurements will be a high priority motivation in the design and selection of any post-GEM tour. A significant design feature of a possible post-GEM tour would be the extension of the mission through the December 2000 timeframe. This would permit the possibility of simultaneous fields and particles experiments coordinated with the Cassini spacecraft as it swings by the Jupiter system for the final gravity assist enroute to Saturn.

The objective of joint observations with Cassini in December 2000 suggested in a non-subtle way that Galileo must remain viable for at least that long. With the GEM tour already in place, and with longevity and cumulative radiation dosage now an issue, the first constraint for the post-GEM tour design becomes one of increasing the orbit period or raising spacecraft perijove as quickly as possible. This is necessary since the GEM design, having brought Galileo to Io on the 24th and 25th orbits, leaves the spacecraft in a

relatively short period orbit subjecting the spacecraft to possible repeated passes through the spacecraft-threatening radiation region associated with each perijove passage. As the paper will show, raising perijove significantly within the time and propellant budgets available proves to be a difficult task. Thus, rather than raise perijove, an alternative strategy of increasing the orbit period has been used as a means for extending the mission. By minimizing the frequency of perijove passages through the high radiation environment, the lifetime of Galileo is likely to be extended and maximizes the probability of the spacecraft surviving through to the Cassini encounter.

An additional design issue results from the original design of the GEM trajectory and the choice of aimpoint made for the Io encounters. The last GEM encounter on November 26, 1999 (a polar flyby of Io) places Galileo in an unfavorable inclination for achieving future satellite gravitational assists -- an obvious necessity for extending the tour. The post-GEM tour is obliged to remove this inclination by either implementing a large apojove maneuver following the I25 encounter or by adjusting the final legs of the GEM tour to enable additional satellite encounters. A discussion of the trades and issues associated with this aspect of the design is detailed.

A possible design for a post-GEM tour has been completed and succeeds in satisfying the levied constraints, and leaves Galileo with a positive predicted propellant margin at the time of the Cassini rendezvous. This post-GEM tour is briefly outlined in the Table below. A plot of the Galileo-Cassini trajectories during the period of interest is shown in the Figure.

	<u>Date</u>	<u>Altitude</u>	<u>Notes</u>
Apojove burn	Dec 15, 1999		22 m/s magnitude
E26	Jan 3, 2000	374 km	
I27	Feb 22, 2000	200	
G28	May 20, 2000	900	
G29	Dec 28, 2000	1000	
Cassini Perijove	Dec 30, 2000	150 Jupiter Radii	

Galileo / Cassini Trajectories

